



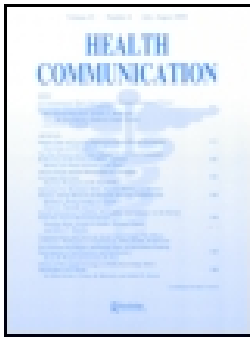
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Can A Funny Story about Tooth Brushing Decrease Plaque Scores in Children? A Longitudinal Field Experiment

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ABSTRACT

Dental caries is the most common chronic condition among children, it is thus a necessity to develop health communication tools to increase children's dental hygiene. Prior research among adults indicates that entertaining narrative communication can promote health behaviors, but knowledge on narrative effects on children's health outcomes is limited. In a repeated measures field experiment (N = 94, 4–10 years) we examined the long-term effects of repeated exposure to a humorous tooth brushing narrative about an orange monkey, versus an expository text on dental care, on children's self-reported and biomedical dental hygiene (plaque scores). We also explored narrative, affective and cognitive processes. Findings showed that the humorous narrative increased character engagement, enjoyment, and moral judgment compared with the expository condition. Enjoyment and moral judgment, in turn, predicted increases and decreases in plaque scores, respectively. We conclude that effectiveness of humorous narrative approach crucially depends on whether the child understands it when a story character is violating the rule.

Caries is the most common chronic condition among children (Bagramian et al., 2009). Tooth brushing, the only way to prevent caries (López-Gómez et al., 2016), is typically promoted through educational means, warning children they should brush their teeth in order to prevent cavities (e.g., Nganjairak et al., 2016). However, such educational campaigns with fear appeals may potentially increase the incidence of dental fear and anxiety, which is quite prevalent among children (about 10%) and already develops at a very young age (Klinberg & Broberg, 2007).

A less threatening, more playful, strategy to promote dental hygiene among younger target audiences is to use an entertaining 'package' to wrap educational messages about dental hygiene. This so-called *entertainment education* approach (Singhal & Rogers, 2002) is used, for example, in Sesame Street to teach children about the world, and social reasoning (Mares & Pan, 2013). While the impact of entertainment education approaches has been well established in the domain of children's academic and social skills (see, e.g., Fisch, 2000; Wilson, 2008), research on health and on longer term outcomes among younger target audiences' behaviors is scarce (but see e.g., De Droog et al., 2014).

The present research takes a narrative persuasion approach to increase good tooth brushing practices and decrease plaque scores among children, with the goal to examine longitudinal effects of reading a humorous children's story entitled "Johnny Joker grits his teeth" (Reiter, 2014) (versus control) on message processing and health outcomes. The research included dental plaque scores to objectively assess the effects of two message types. In the story condition, we chose to use a humorous

narrative because humor has the potential to alleviate threat, which is relevant given dental fear and anxiety rates (Klinberg & Broberg, 2007; Yoon & Tinkham, 2013). In the expository condition, participants read a standard educational leaflet that is part of usual dental care practice. While evidence has been reported for beneficial effects of narratives about the positive consequences of desired behaviors among children outside the health domain (Du & Hao, 2018; Lee et al., 2014; Talwar et al., 2016), empirical support for the effects of messages that present the negative consequences of undesired behaviors to this target group is lacking.

A second goal of this research was to increase understanding of the processes that play a role in the impact of humorous health narratives on children's health outcomes. We have identified three key components of the Johnny story: 1) the text has a story structure and presents a main character with specific traits, 2) the story is humorous, 3) the main character's actions are evaluated negatively by significant others. Based on these three aspects, we identified three parallel processes; a character engagement process, a peripheral affective process, and a systematic cognitive process that may mediate the effect of health messages. In the following, we describe these processes and then report the findings of a longitudinal field experiment.

Narrative processes: Children's engagement with story characters

A narrative is defined as "any cohesive and coherent story with an identifiable beginning, middle, and end that provides

information about scenes, characters, and conflict” (Hinyard & Kreuter, 2007, p. 778). Narratives are powerful persuasion vehicles because they can increase attention for a message, and casually inform readers about relevant facts and practices while they are transported to the story world and engage with story protagonists, as research among adult population has shown (De Graaf et al., 2012; Moyer-Gusé, 2008).

Learning from fiction requires an understanding of the boundary between reality and fiction, and the understanding of which information is worth transferring from reality to fiction (Walker et al., 2012). Previous studies indicate that these capabilities develop considerably during the preschool years from the age of 4 (e.g., Ganea et al., 2011; Walker et al., 2012). From the age of 2 years, children start to form relationships with people other than their parents, including humans and story protagonists they encounter in the media (McNeal, 2007). Children’s understanding of story protagonists develops grossly parallel to the stages of cognitive development (Piaget & Cook, 1952).

To what extent previously observed persuasion effects are driven by specific character engagement, i.e., an umbrella term for readers’ cognitive and emotional bonding with characters in children’s narrative persuasion process (De Graaf et al., 2012; Moyer-Gusé, 2008), is largely unknown, as empirical evidence among this target group is scarce and scattered across disciplines. We identified four relevant (closely related but distinct) types of character engagement that could play a role in the persuasion process; perceived similarity, wishful identification, parasocial relationship, and liking. Character engagement is often measured in general liking terms, assessing the perceived positive attributes of a character (Hoffner & Buchanan, 2005). More specific engagement conceptions vary in the degree to which they are based on perceptions of similarity. The concept of perceived similarity assesses to what extent children feel similar to a character, in terms of resemblance of objective or subjective qualities (Murphy et al., 2013). The concept of wishful identification assesses to what extent a child wants to emulate the character, as a role model, ‘to be like the character’ (Hoffner, 1996; Hoffner & Buchanan, 2005). The concept of parasocial relationship is generally defined as an imaginary friendship; the one-sided impression that the child is investing in, and interacting with a story character (Brown, 2015; Brunick et al., 2016; Rosaen & Dibble, 2008).

As stated previously, evidence on the role of these different character engagement conceptions on health outcomes in children is limited. Some studies have reported positive effects of character popularity on the consumption of the product it promotes (Acuff & Reiher, 2014; De Droog et al., 2011; Roberto et al., 2010). Other studies reported that prosocial characters can increase prosociality in children (de Leeuw & van der Laan, 2018). One study reported that children can take on the traits of story characters (Dore et al., 2017). Furthermore, research in the context of violent video games has shown that adolescents who played a violent game and wished they were like a violent character in the game showed the most aggressive behavior (see, e.g., Konijn et al., 2007). Finally, parasocial interaction with media characters was positively related with 7- to 12-year-olds’ perceptions of the characters as kind, helpful, and caring (Hoffner, 1996), and

parasocial relations with the Johnny Joker character predicted toddler’s (positive) post-exposure attitudes toward tooth brushing (Das et al., 2018).

A first goal of the present research was to assess if a narrative experimental condition increases character engagement (i.e., liking, perceived similarity, wishful identification, and parasocial relationship) compared with an expository control condition in the context of tooth brushing. Next to assessing differences between conditions, we assessed the (in)direct relationship between (general) character engagement and health outcomes.

Peripheral affective processes: Enjoyment

The process of affect transfer explains how children appreciate the humorous content in narratives such as Johnny Joker. Humor can be defined as a response (i.e. perceived funniness of the message) or can be described by the humor-eliciting components of a message (Martin & Ford, 2018). In the children’s book “Johnny Joker grits his teeth” (Reiter, 2014), we can see several types of humor, such as physical discrepancy (e.g., monkeys are orange, and dressed up and act like humans), exaggeration (e.g., a friend faints when smelling Johnny’s bad breath; Johnny cannot open his mouth anymore because it is so sticky), violation of expectations (e.g., Johnny’s witty punchlines to a friend’s critique), and violation of rational behavior or absurdity (e.g., Johnny’s brushing teeth with chocolate paste or soap) (see overview on humor types in Table 3) (Buijzen & Valkenburg, 2004; Klein, 2003). We expect that these components elicit fun and enjoyment in children readers.

According to classic persuasion models, e.g., Petty & Cacioppo, (1986), the positive feelings evoked when processing entertaining content are easily transferred to the behavior promoted in the message, resulting in a more positive response toward that behavior. This would imply that the narrative condition that uses personal hygiene relevant behaviors as a source of humor for the target group in our research, may increase persuasion, compared with the expository condition, simply because it is more enjoyable for children. In line with this assumed role of enjoyment, a previous pre-post study on effects of the book “Johnny Joker grits his teeth” among children between 4 and 6 years old showed that enjoyment, i.e., the extent to which children liked the book, significantly and positively correlated with children’s post-exposure attitudes toward tooth brushing (Das et al., 2018).

In terms of health effects, the strategy that is used in the narrative condition of the present study, by which the portrayal of negative evaluation and consequences of unwanted behaviors is combined with humor, runs the risk of backfiring and producing negative effects on health outcomes. Specifically, the positive affect elicited by the humorous story may transfer to the behaviors shown in the story, and thus motivate unwanted behaviors such as not brushing one’s teeth, or brushing one’s teeth with chocolate. Although there is no empirical evidence among children, such backfiring effects have previously been reported among an adult sample (Moyer-Gusé et al., 2011). Another goal of the present research was therefore to assess if, indeed, children find the humorous experimental condition

more enjoyable than the expository control condition, and to explore to what extent this increased enjoyment translates into (positive or negative) health outcomes.

Systematic cognitive processes: Moral reasoning

Humor may also affect cognitive processes. Specifically, adding humor to threat messages has been shown to decrease defensive responses and increase message processing motivation among adult target audiences (Mukherjee & Dubé, 2012; Nabi, 2016). Such beneficial cognitive effects of humor are relevant given dental fear and anxiety rates among children (Klinberg & Broberg, 2007). For younger target audiences, however, the socially undesired behavior of the Johnny character represents a violation of expected behavior that needs to be understood. Moral reasoning develops with age (Ongley et al., 2014), and it should be pivotal for children to know that Johnny's behavior is breaking the rules. If children do not understand this, the rather subtle negative consequences the Johnny character experiences in the book may not be enough to steer children's behavior in the right direction.

In entertainment education narratives, the embedded message is often communicated via the protagonist's behavior. Such behaviors can be framed in a positive way, by showing the positive consequences of a recommended behavior such as positive emotions and social acceptance; in a negative way, by showing the negative consequences of undesired behavior such as negative emotions and social rejection (De Graaf et al., 2016). Several studies have shown that positively framed narratives, i.e., narratives that show the positive consequences of a recommended behavior, increased children's character strengths (Du & Hao, 2018; Lee et al., 2014; Talwar et al., 2016). One study reported beneficial effects of a negatively framed message accompanied by negative emotions on children's helping behavior (Du & Hao, 2018).

In the present study, the narrative condition contains several cues that reveal the significant other characters' negative evaluation of the main character's funny behavior, expressed through explicit and implicit gestures.¹ According to Bandura's social cognitive theory (Bandura, 2009), vicarious incentives are an important factor that determine whether an observed behavior is emulated by the observer. Vicarious incentives give information about the observed costs and benefits of a certain act, and also help to predict whether the behavior would be sanctioned or rewarded by others. It seems that people in general are more sensitive to punishment than to reward when learning new behaviors (see Baumeister et al., 2001). Several studies have shown that children's anticipation of others' negative emotions as a potential reaction to a socially negative behavior is an important factor in eliciting positive behavior (Paulus & Moore, 2015). Du and Hao (2018) found that a story that showed how others reacted negatively toward the main character's negative behavior compared to control story increased prosocial intentions in children.

Depending on their age, in the present research children may or may not understand the moral implications of the behavior of the main character Johnny in the narrative condition. In order to assess to what extent children understand that the Johnny character violates the norm, the present research

included a measure of Moral Judgment that assessed to what extent the children found the characters in the different conditions naughty and mischievous.

We propose that these three routes – narrative, affective and cognitive – are interrelated. Character engagement is an important mediator to enjoyment, whereas moral judgment – the recognition that the main character's action (harmlessly) violate a rule – can be a source of humor and fuel enjoyment (Warren & Peter McGraw, 2016). Therefore, we also explored the relationship between character engagement, moral judgment, and enjoyment.

The present research: Theoretical model

The present research is a field study, with high ecological validity. The study used A/B testing design in order to find out if the standard way of informing children about tooth brushing can be improved by means of entertainment education (for more details about A/B testing, see Kohavi & Longbotham, 2017). This research design does not allow us to exactly tell what makes the difference between reading the humorous narrative and the standard educational leaflet; however, it informs us whether there is a difference at all.

A first goal of this study was to assess the effects of a humorous narrative with a negative frame versus a standard educational approach on health outcomes over time, i.e., attitudes and intentions toward tooth brushing, and decreased plaque scores (RQ1). A second goal of this research was to explore the narrative, affective and cognitive processes that may drive the observed effects. See Figure 1 for our theoretical model.

Regarding the narrative route, we formulated the following research hypothesis and research question:

H1: Compared with the expository condition, the story condition will elicit higher levels of character engagement.

RQ2: What is the relationship between character engagement and health outcomes?

Regarding the affective route, we formulated the following hypothesis and research question:

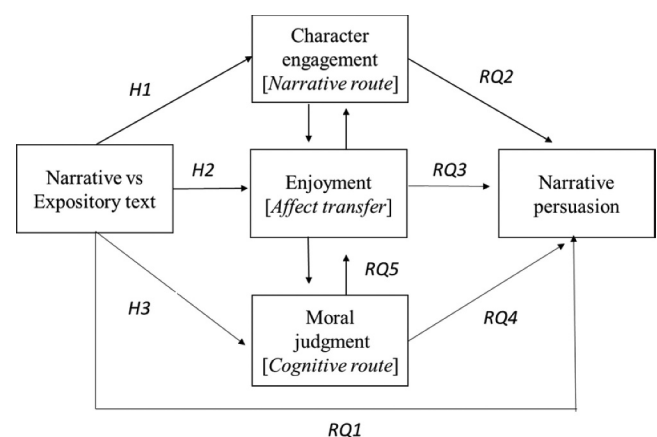


Figure 1. Theoretical model of the study. Arrows express expected effects.

H2: Compared with the expository condition, the story condition will elicit higher levels of enjoyment.

RQ3: What is the relationship between enjoyment and health outcomes?

Regarding the cognitive route, we formulated a research hypothesis and research question:

H3: Compared with the expository condition, the character in the story condition will be judged as more naughty and mischievous.

RQ4: What is the relationship between moral judgment and health outcomes?

RQ5: What is the relationship among the mediating variables (character engagement, enjoyment and moral judgment) (i.e. serial or parallel)?

Method

Design

This study used a randomized treatment control design. Participants were randomly assigned either to the control (factual information, from now on *expository condition*) or treatment (humorous fictional story, from now on *story condition*) condition. In both groups, parents were asked to read the text together with the child every other day, or/and encourage the child to read it by herself, in the course of 1 month. We employed three measurement points (T1, T2, T3) with approximately two-week intervals among measurements. Self-reported dental measures were assessed at T1, T2, and T3. Biomedical measures of dental hygiene were assessed at T1 and T3. Self-reported responses to the text (i.e. wishful identification, parasocial relationship, perceived similarity, liking, and moral judgment) were measured at T2.

Participants

Native Dutch-speaking children between the ages of 4–10 years were invited to this study between 6 October 2017 and 16 May 2018. Apart from age and mother tongue, there were no other exclusion criteria to guarantee a broader patient group. Table 1 shows the sample size, age, and gender distribution at T1, T2, and T3 in the total sample and the two experimental groups. Distribution of age: 4–5 years ($n = 27$), 6–7 years ($n = 45$), 8–10 years ($n = 21$). Gender, age, trait,

and state dental anxiety, pre-intervention plaque score of participants did not differ significantly across experimental conditions at Time 1 ($p > .10$).

Procedure

The experiment took place in *Centrum voor Tandzorg*, a general dental practice in Rosmalen, The Netherlands. Participants were recruited in the dental practice by a dental assistant, with approval from the dental practice and the children's parents. Because the interventions used in this study do not deviate from usual care in dental practice, the research was exempt from ethics approval.

Table 2 briefly summarizes the sessions. During Time 1, parents were instructed by the dental assistant who explained how to deal with the questions targeting the child, i.e. assisting them without influencing the answer. Parents signed the informed consent, and filled in the survey on a tablet. Questions targeting the children were filled in by the child alone or with the help of the parent. Items targeting the children respondents used a 5-point visual facial image scale developed and validated by Buchanan and Niven (2002) to measure children's responses in dental context. These items presented five line-drawn faces displaying facial expressions from unhappy (disagreement) to happy (agreement).

In both groups, parents were asked to read the material together with the child every other day, or let the child read the book alone if that was more suitable, in the following 1 month. At the end of the session, the dental assistant arranged a next appointment to the dental practice in 4 weeks approximately. After each week parents received an e-mail reminder to keep reading the material. Participation was voluntary and participants received no reimbursement for their participation.

Materials

The treatment group received a humorous children's book (*Johnny Joker* by Reiter, 2014), in which the educational message is integrated into a story about an orange monkey who promotes healthy behavior in an unconventional way. Unique to the story is that the character also tries out various non-recommended behaviors like brushing his teeth with chocolate, thus representing a funny yet ambiguous role-model. Although the monkey is not explicitly punished for these behaviors, the book does portray negative consequences such as his friends telling him off for smelling bad, and not being able to eat his favorite food because his teeth stuck together from not haven been brushed properly.²

The expository group received an educational, non-narrative, leaflet about tooth brushing that is used as

Table 1. Sample size, age, and gender distribution at the first measurement (T1), second measurement (T2), and third measurement (T3) in the total sample and the two experimental groups.

	T1			T2			T3		
	N	Age in years M (SD)	Gender	N	Age in years M (SD)	Gender	N	Age in years M (SD)	Gender
Total	94	6.41 (1.37)	52 M; 42 F	661	6.52 (1.41)	34 M; 27 F	63	6.51 (1.34)	35 M; 28 F
Story condition	46	6.46 (1.35)	26 M; 20 F	335	6.40 (1.42)	20 M; 15 F	31	6.42 (1.26)	17 M; 14 F
Expository condition	38	6.37 (1.40)	26 M; 22 F	226	6.69 (1.41)	14 M; 12 F	32	6.59 (1.43)	18 M; 14 F

Table 2. Brief summary of session at the three time points of assessment.

Summary of sessions	
Time 1	Checking inclusion criteria. Parents sign informed consent. Pre-intervention measures in dental practice. Assessing baseline dental health-related intention and attitude toward tooth brushing, dental anxiety, and dental plaque score. Randomly assigning child to one of the two experimental conditions.
Time 2	Two weeks after T1. Online survey assessing intention and attitude toward tooth brushing, children's responses to the experimental materials (enjoyment, wishful identification, parasocial relationship, perceived similarity, moral judgment), parents' perception of the texts, and control questions.
Time 3	Two weeks after T2. Post-intervention measures in dental practice, approximately one month later. Assessing dental anxiety, intention and attitude toward tooth brushing, and dental plaque score.

standard care in dental practices. The leaflet shows pictures of children being at the dentist or brushing their teeth, and includes information about why tooth brushing is important and how it should be done. The information leaflet entitled *Tooth brushing with children* (Tandenpoetsen met kinderen; <https://www.ivorenkruis.nl>) was developed for children under the age of 12 by a scientific organization (Ivoren Kruis) in cooperation with the Advisory Board for the Prevention of Oral and Dental Diseases in The Netherlands. The leaflet explains why it is very important to brush twice a day for 2 minutes, what type of toothbrush and toothpaste you need to use, how to brush teeth, and other tips on brushing teeth for children. The recommendations are illustrated with pictures of real children.

Measures

The study collected responses from the children participants, and also from parents and the dental assistant. See further details on instructions in the Procedure section. Children indicated their responses on a standardized 5-point facial image scale (Buchanan & Niven, 2002) unless otherwise indicated.

Self-reported dental hygiene (measured before and after exposure to the texts)

Children indicated their *attitude toward tooth brushing* on two items, for example: "Do you like brushing your teeth?"; "How happy does it make you to brush your teeth?" using a facial image scale. Attitude was measured pre- and post-treatment

(Spearman – Brown coefficient $\text{pre-intervention} = .83$; Spearman – Brown coefficient $\text{post-intervention} = .63$). Higher scores indicate more positive attitude toward tooth brushing. Children reported their *intention to brush teeth* on two items with a facial image scale (Spearman – Brown coefficient $\text{pre-intervention} = .75$; Spearman – Brown coefficient $\text{post-intervention} = .79$), these are: "Do you want to brush your teeth every day?" "How much would you like to brush your teeth every day?" Intention was measured pre and post-treatment. Higher scores indicate higher intentions to brush teeth.

Biomedical measure of dental hygiene (measured before and after exposure to the texts)

The child's plaque score was assessed according to the Simplified Oral Hygiene Index (Greene & Vermillon, 1964) by the dental assistant, at pre- and post-treatment on a 4-point scale ranging from "0" (no plaque) to "3" (more than two-thirds of teeth surface is covered by plaque). We created a *plaque change score* by extracting the post-intervention score from the pre-intervention score. Lower values indicate an increase, higher values indicate a decrease in plaque score.

Responses to the textual material (measured once, after exposure to the texts)

Reading frequency of child was assessed by asking the parent to indicate approximately how many times the child had read the text by herself. Higher scores indicate a higher frequency of reading. *Reading frequency of parent to child* was assessed by asking the parent to indicate approximately how many times the parent read the text to the child. Higher scores indicate a higher frequency of reading.

Character engagement

Children's parasocial relationship with the main characters was assessed by five items (see Das et al., 2018; Cronbach's $\alpha = .85$), there were "How much do you feel about Johnny as a friend?" "How well do you think Johnny can understand you?" "How much would you like to meet Johnny in real life?" "How much would you like to read another story about Johnny?" "How much would you like to more about Johnny?". Higher scores indicate higher levels of parasocial relationship. Children's *wishful identification* with the main characters in the texts was measured by three items, these are

Table 3. Descriptives in the story and expository conditions. Mean and standard deviation (in brackets). *P* values of independent sample t-tests indicate if there was a significant difference between conditions in the output variables.

Dependent variables	Expository condition	Story condition	<i>t</i> (df)	<i>p</i>
Character engagement	2.58 (0.86)	3.02 (0.87)	−1.93 (54.02)	.059
Perceived similarity	1.96 (1.25)	1.95 (1.22)	0.02(57)	.983
Wishful identification	2.55 (1.02)	2.16 (1.22)	1.31(57)	.197
Parasocial relationship	2.53 (1.02)	3.64 (0.95)	−4.30 (57)	<.001
Liking	2.81 (0.84)	3.44 (0.96)	−2.67(57)	.009
Enjoyment (child)	2.82 (1.26)	4.25 (0.92)	−4.86(44)	<.001
Moral judgment	2.54 (1.11)	3.35 (1.37)	−2.45(57)	.017
Reading frequency (child)	2.58 (1.90)	4.00 (3.05)	−2.22(56)	.031
Reading frequency (parent)	4.81 (1.88)	5.29 (2.54)	−0.85(58)	.397

“How much would you like to be Johnny?” “How much would you like to do what Johnny did in the book?” “How much would you like to look like Johnny?” (Adapted from Hoffner, 1996; Cronbach $\alpha = .74$). Higher scores indicate higher levels of wishful identification. Children’s *perceived similarity* with the characters in the experimental materials was measured by two items, these are “How much do you think Johnny is like you?” “How much do you think you are like Johnny?” (Spearman–Brown Coefficient = .93). Higher scores indicate higher levels of perceived similarity. Children’s *liking of the characters* was measured by two items created for this study by the authors, i.e., “How funny is Johnny?” “How nice is Johnny?” (Spearman–Brown Coefficient = .53). Higher scores indicate more liking. All engagement measures were assessed using facial scales designed for children. Note, that in all character engagement scale items, the name Johnny was replaced by “child on leaflet” referring to the girl on the leaflet in the expository condition. We used factor analysis to create an aggregated *character engagement* scale that includes the items of the four scales mentioned in this paragraph (13 items, Cronbach $\alpha = .84$).³

Enjoyment

Children’s enjoyment of the text (facial image scale) was assessed by asking the children to indicate their enjoyment of the text on three items created for this study by the authors (“Do you like the book/text?” “Do you find it a funny book?” “Do you want to have another book/text like this?”) (Cronbach’s $\alpha = .87$). Higher scores indicate higher enjoyment.

Moral judgment

Children’s moral judgment of the characters (facial scale) was measured by two items created for this study by the authors, i.e., “How naughty is Johnny?” “How cheeky is Johnny?” (Spearman–Brown Coefficient = .81). Higher scores indicate more negative moral judgment.

Age, gender, child’s state dental anxiety reported by child (Buchanan & Niven, 2002) and child’s trait dental anxiety reported by parent (adapted scale by Buchanan & Niven, 2002) were included as *control* variables.

Statistical analysis

All analyses were 2-tailed with a p -value threshold of 5% and run using SPSS (version 25.0).

Attrition of participants from T1 to T2 was not random, attrition rate was higher in the expository group ($N = 22$) than in the story group ($N = 11$), $\chi^2(1) = 5.00$, $p = .026$. For participants who did not complete the second survey ($N = 33$) or the third survey ($N = 31$), data were imputed using the predictive matching mean method (Van Buuren, 2018).⁴

Results

Randomization check

The experimental and the control group did not differ at Time 1 in participant age, $t(92) = -0.29$, $p = .775$, gender, $\chi^2(1) = .05$,

$p = .818$, dental anxiety trait, $t(92) = 0.71$, $p = .478$, and dental anxiety state $t(92) = 0.764$, $p = .447$. This indicates that the randomization was successful.

Effect of experimental conditions on character engagement, enjoyment and moral judgment responses

Independent t-tests showed (see details in Table 3) that the story condition increased parasocial relationship, and liking of the character, enjoyment, and moral judgment, as well as reading frequency by child. No differences were found for overall character engagement, wishful identification and perceived similarity. Based on these findings, H1, which proposed that the story condition would increase character engagement, compared with the expository control condition, is partially accepted. H2 and H3, which proposed that the story condition would increase enjoyment and moral judgment, respectively, are accepted.

Effects of experimental conditions on health-related variables

To answer RQ1 about differences between experimental conditions on health outcomes over time, we conducted repeated measures ANOVA with the experimental conditions as between-subject variable and the factor of time [baseline (T1), mid-intervention (T2), post-intervention (T3)] as within-subject variable. The analyses showed that participants’ attitude and intention toward tooth brushing, and state dentist anxiety were not affected by the experimental conditions across the three measurement points (see details in Table 3). Post-hoc t-tests to further investigate interaction effects were LSD corrected. Plaque score did not differ at T1 ($t(92) = 0.62$, $p = .54$) and T3 ($t(92) = -1.19$, $p = .23$) within groups, however, participants’ plaque score was affected by the experimental condition across the two measurement points indicated by an interaction effect of time and condition. Plaque score showed a slight decrease in the expository condition and a slight increase in the story condition. See details in Table 4.

Mediation analysis

To answer RQ2, 3 and 4 about the role of narrative, affective, and cognitive processes in the effects of the experimental conditions on health outcomes, we first tested the effect of age and gender on plaque change scores in a linear regression analysis (enter method, 10,000 bootstrap resamples). Results showed no significant effects of age ($p = .776$) and gender ($p = .925$). Given the wide age range in our sample, we ran the mediation analyses with and without age as a covariate in the mediation analysis, which did not affect the results. Below we report the findings with age as a covariate.

The indirect effect hypothesis was tested using a bootstrap estimation approach with 10,000 samples in PROCESS Model 6 (Hayes, 2013). Conditions were inserted as predictor variable, plaque score change as output variable, and the aggregated character engagement scale,⁵ enjoyment and moral judgment as mediator variables. The relationship between experimental condition and plaque score change was mediated by moral judgment and enjoyment, but not by character engagement.

Table 4. Descriptives of output variables across time. F statistics indicates the interaction effect of condition and time on the dependent variable.

	T1	T2	T3	F (df, error)	p	Effect size
<i>Attitude toward tooth brushing</i>				0.31 (2, 184)	.658	.003
Story condition	3.42 (1.30)	3.46 (1.00)	3.33 (1.14)			
Expository condition	3.32 (1.18)	3.36 (1.00)	3.43 (1.02)			
<i>Intention toward tooth brushing</i>				0.15 (2, 184)	.82	.002
Story condition	3.60 (1.24)	3.80 (1.11)	3.71 (1.21)			
Expository condition	3.26 (1.18)	3.55 (1.23)	3.51 (1.27)			
<i>Child's dental anxiety state (Child)</i>				0.64 (1, 92)	.478	.005
Story condition	1.80 (0.81)	n.d.	1.92 (0.74)			
Expository condition	2.03 (1.01)	n.d.	2.02 (1.00)			
<i>Plaque score</i>				4.01 (1, 92)	.048	.042
Story condition	0.67 (0.63)	n.d.	0.80 (0.65)			
Expository condition	0.75 (0.56)	n.d.	0.65 (0.64)			

Note. n.d. = no data

As Figure 2 illustrates, the standardized regression coefficient between experimental condition and moral judgment was statistically significant ($b = 0.74$, $p = .03$), as was the standardized regression coefficient between experimental condition and enjoyment ($b = 1.05$, $p > .001$), whereas the standardized regression coefficient between experimental condition and character engagement showed a trend ($b = 0.40$, $p = .076$). We tested the significance of these indirect effects using bootstrapping procedures. Partially standardized indirect effects were computed for each of 10,000 bootstrapped samples, and the 95% confidence interval was computed. The partially standardized indirect effect of experimental condition on plaque score through moral judgment was significant ($b = -0.18$, bootstrapped CI $[-0.42; -0.01]$), as well as through enjoyment ($b = 0.41$, bootstrapped CI $[0.09; 0.85]$). The model presented in Figure 1 is significant ($p = .006$) and explains 22% of the variation in plaque score change. The results indicate that the story condition compared to the expository condition increased enjoyment in children, which in turn increased plaque score. Furthermore, the story condition elicited moral judgment, which in turn decreased plaque score. To answer RQ5, we tested whether enjoyment, moral judgment and character engagement affected each other in the mediation, and the analysis showed a serial effect of character engagement and enjoyment, and an independent effect of moral judgment on health outcomes. Table 5 presents the values for the indirect effects.

Additional analysis on reading frequency and age

As Table 3 shows, the story condition significantly increased reading frequency. In a stepwise linear regression analysis, we tested if any of the reader responses or age and gender

predicted reading frequency. Results showed that the single item “How funny is Johnny?” explained 12% of the variance in the child’s reading frequency ($F(1, 59) = 9.22$, $p = .004$). All other variables were non-significant in the model.

Age negatively correlated with parasocial relationship $r(59) = -.18$, $p = .043$, all other character-related responses were uncorrelated with age. Additionally, we compared children’s perception of funniness above and under the age of 7 to see if we can replicate the findings of previous studies on the role of age on the perception of humor, however, we found no significant differences between these two age groups ($p > .10$). The averages within the story condition group indicated that children found the Johnny-story quite funny, suggesting that they understood the joke-status of the narrative. The significant difference between the experimental conditions on funniness ($p = .003$) also indicates that children in this age range are able to differentiate humorous and non-humorous texts. Furthermore, gender had no significant effect of children’s perception of the text and the characters ($p > .10$).

We also tested the level of correlation between moral judgment and enjoyment in the different age categories ($4-5y \rightarrow R = .495$, $p = .061$; $6-7y \rightarrow R = .427$, $p = .021$; $8-9y \rightarrow R = .259$, $p = .350$). We tested the correlation between funniness of Johnny and moral judgment, we found similar patterns, the correlation only significant in the age category of 6–7y.

Discussion

This repeated-measures field experiment examined long-term effects of a humorous health narrative (versus a standard expository message) on dental health outcomes, including changes in plaque score. Whereas the story condition of the present research used a funny character that was subtly punished by

Table 5. Results of Mediation Model (Model 6, Hayes, 2013). Partially standardized indirect effect(s).

Indirect effect type		b	SE	[LL, UL BCa 95% CI ^a]
Ind1	Condition \rightarrow Character engagement \rightarrow Plaque score change	−0.07	0.09	[−0.29, 0.09]
Ind2	Condition \rightarrow Moral judgment \rightarrow Plaque score change	−0.18	0.11	[−0.43, −0.01]
Ind3	Condition \rightarrow Enjoyment \rightarrow Plaque score change	0.42	0.20	[0.09, 0.86]
Ind4	Condition \rightarrow Character engagement \rightarrow Moral judgment \rightarrow Plaque score change	−0.02	0.03	[−0.10, 0.02]
Ind5	Condition \rightarrow Character engagement \rightarrow Enjoyment \rightarrow Plaque score change	0.09	0.06	[−0.01, 0.23]
Ind6	Condition \rightarrow Moral judgment \rightarrow Enjoyment \rightarrow Plaque score change	0.04	0.04	[−0.03, 0.11]
Ind7	Condition \rightarrow Character engagement \rightarrow Moral judgment \rightarrow Enjoyment \rightarrow Plaque score change	0.00	0.01	[−0.01, 0.03]

^aBootstrap sample size = 10 000; Ba 95% CI, bias-corrected and accelerated confidence interval; LL = lower limit; UL = upper limit.

NB Bold indicates significant paths.

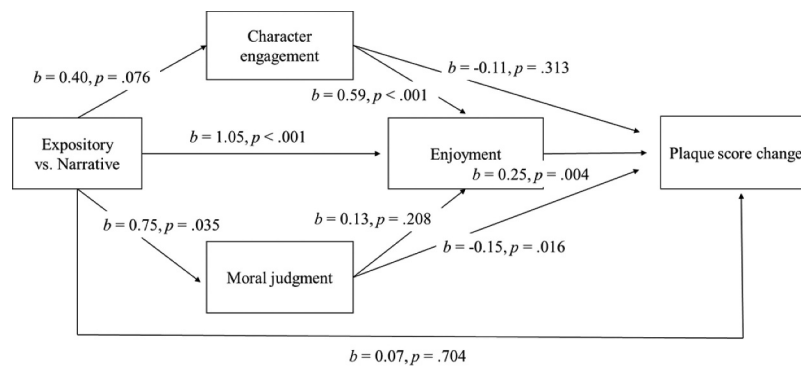


Figure 2. Mediation analysis with conditions as predictor, plaque score change as dependent variable, age as covariate, and character engagement, child's enjoyment and moral judgment of the protagonist as mediator variables. A bootstrap method with 10,000 resample was used, bootstrapped intervals are reported for indirect effects.

peers for undesired behaviors in a narrative, the expository condition used a standard leaflet to explain the importance of dental hygiene in current dental practice. Extending previous research, this study included biomedical health outcomes, and examined health message effects over a longer period of time. Additionally, the research explored to what extent health message effects on health outcomes were mediated via narrative, peripheral affective, and systematic cognitive processes.

A key finding of this research is that the effects of the humorous narrative (versus the standard expository condition) on health outcomes crucially depended on children's enjoyment of the narrative and moral judgment of the character. These seem to represent two different routes through which health outcomes are shaped: a peripheral, enjoyment-driven route, and a more systematic, judgment driven route. The enjoyment-driven route reflects the affect transfer process that has been proposed to play a large role in the effects of persuasion among children; a process through which emotions and associations triggered by the message may transfer to products or behaviors associated with the message (Buijzen et al., 2010; Valkenburg, 2008). The second route reflects the more deliberate cognitive processes through which the character's norm violating behavior is interpreted, evaluated and understood. The third, narrative route that we specified in the present research did not play a role in driving health outcomes.

The observed finding that the narrative condition increased enjoyment, which, in turn, negatively affected children's plaque score changes over time suggest that the currently observed combination of humor and a negative message frame is a risky strategy to decrease plaque scores among young children. The positive affect triggered by the humorous narrative may transfer to the undesired behaviors shown in the narrative via the peripheral process of affect transfer, a finding that has also been previously been observed among adults (Moyer-Gusé et al., 2011). Additionally, the fact that moral judgment of the character decreased plaque scores over time underscores the importance of children's understanding that the character's behavior is "wrong."

These findings are crucial for narrative health message designers as they indicate that there is a fine balance between enjoyment and awareness of the right behavior. On the one hand, positive message frames that more explicitly show the right behavior, or story lines with more explicit disapproval of

negative behaviors, may decrease the currently observed negative relationship between enjoyment and plaque score change. On the other hand, positive message frames might decrease enjoyment and reading frequency, which was stimulated by the naughty, funny character in the present research. The finding that the humorous quality was an important predictor of reading frequency underscores that funny stories may be effective to increase children's attention to relevant health topics, most likely because they are better liked than standard education material. This increased attention and enjoyment is important because it might give health professionals and parents leverage to discuss health issues that might otherwise be regarded as "boring."

A third noteworthy finding is that, although the story condition increased engagement with the character, compared with the control condition, character engagement did not predict health outcomes. The character in the humorous narrative was liked better, and elicited higher level of parasocial relationship, but there were no differences between conditions on wishful identification or perceived similarity with the characters. The mediation analysis indicated that character engagement increased enjoyment. This is in line with previous studies showing the important role of character engagement in enjoyment (Tal-Or & Cohen, 2010). However, the serial indirect effect on health outcomes through character engagement and enjoyment was not significant (see Table 5). Future studies should follow up on this using larger sample size.

These findings tentatively suggest that character engagement may not be a crucial factor in children's persuasion process following exposure to different health messages. This is not to say that narratives are ineffective persuasion vehicles among young audiences; indeed, there is ample evidence that stories can be used to teach children about worldviews, skills, and behaviors (e.g., Mares & Pan, 2013). Rather, our findings suggest that peripheral affective processes, and systematic cognitive processes, may be more important drivers of young children's (health) behavior change following entertaining content (also see Buijzen et al., 2010). It may be that these findings are age-dependent; for example, perspective-taking skills develop with age, and therefore engagement processes may start to play a larger role for older children. Age and gender did not affect these responses in this study, this could

be due to the sample size, it is therefore up to future research to shed further light on this issue.

We tested if age had a role in children's perception of the narrative. The results indicated that older children were less likely to develop parasocial relationship with the main protagonist, however all other character engagement responses, enjoyment and moral judgment were uncorrelated with age. Older (7–10y) and younger children (4–6y) found the story similarly funny. The averages within the story condition group indicated that children found the Johnny-story quite funny, suggesting that they understood the joke-status of the narrative. The results also indicated that negative moral judgment (naughtiness, cheekiness) and perception of funniness were related only within the age group of 6–7 year olds, but not above or under. This finding may also indicate that the norm violations described in the book are especially funny for a younger age group, and then are perceived as 'childish' later on.

Finally, the present field study that was aimed at investigating longer-term narrative effects in a naturalistic design differed from more controlled laboratory experiments with regard to the time between reading the experimental materials and filling out the questionnaires. We asked parents to read the material together with the child every day, and to fill out a questionnaire three times across a time frame of 4 weeks. The time between reading the materials and filling out the questionnaires is likely to be longer than in laboratory experiments that usually assess post-measures immediately after reading. Because the latter procedure may artificially boost post-measure effects through priming, one might argue that the lack of findings observed on, for example, children's health attitudes and intentions, may better reflect the reality of persuasion processes in daily life. Alternatively, because the present research did report effects on measures of narrative processing, and on plaque score change, it may be that the route for narrative persuasion effects may be paved with implicit, rather than explicit, responses. Future studies should further investigate this matter.

Limitations and future directions

Some limitations of this study must be acknowledged. The study compared a non-narrative expository test with a narrative condition. This method is suitable to decide which variant of two messages is more effective in eliciting certain responses, but it is not suitable to identify specific factors carrying the effect. To identify specific effects of humorous messages and/or narrative messages, future studies should explicitly compare specific message features, such as a narrative with and without humor, or a health message with a positive versus negative frame. Furthermore, the experimental A/B design of the present study did not allow for testing whether moral judgment of the naughty character *changed* the relationship between enjoyment and plaque scores. This issue should be addressed in a future study that assesses the effects of moral judgment in a humorous narrative that, for example, varies morally ambiguous behavior in two otherwise similar conditions. Furthermore, although the present study assessed to what extent children found the character naughty and cheeky, we did not explicitly children's measure comprehension of moral behavior. Future studies should include

ways to get insight into how children understand moral behaviors of others in order to further the understanding of the underlying mechanisms. Investigating this would provide information on the underlying mechanisms of humor comprehension in the context of narrative persuasion.

This study asked parents to report the frequency of their daily reading. This measure suffers from the general limitations of self-report measures of media use, namely participants tend to under and over report their media use. Alternative ways of measuring media use, e.g., journaling offline or online, are more accurate but put a higher burden on participants that might lead to higher attrition. Furthermore, we did not collect information on the extent to which parents and children interacted during reading. It can be that the story condition triggered more interaction than the expository condition. We did not administer neither on children's prior knowledge on the importance of tooth brushing, nor whether parents helped children with tooth brushing or the children brushed their teeth alone. Due to random assignment to experimental groups these did not affect our results, although they may be crucial underlying factors that future studies need to include into their investigation.

An important finding not only from a methodological perspective, but also from a message design perspective is that attrition was not distributed equally across conditions. There was a significantly larger level of dropout from the expository condition. On the positive side, this may be due to the fact that the story condition was better able than the expository condition to keep participants interested. On the negative side, this selective attrition may have biased our findings. Future studies should make sure to keep control conditions on board, perhaps by incentivizing participants more effectively.

Conclusion

Whether or not funny stories about how not to behave can be used to effectively promote young children's health outcomes crucially depends on whether they are aware of that the character's behavior is 'wrong.' Without this recognition in children, such funny stories may backfire on health outcomes. Our findings further show that children's enjoyment of the text and moral judgment of the character predicted changes in plaque scores, a highly objective biomedical indicator of dental hygiene. Character engagement processes did not predict health outcomes. The findings reveal important factors for narrative health communication targeting children.

Notes

1. The detailed analysis of the story content is available upon request from the corresponding author.
2. The text is available upon request from the corresponding author.
3. Supplementary analysis is available upon request from the corresponding author.
4. Detailed attrition analysis is available upon request from the corresponding author.
5. In the mediation analysis we used the aggregated character engagement scale to increase power. The sample size is too low to add all

character-related scales separately. We tested whether the separate scales (parasocial relationship, etc.) act as mediators, but none of the effects reached conventional significance levels.

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